Community COVID-19 activity level and nursing home staff testing for active SARS-CoV-2 infection in Indiana

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KU is CEO and Founder of Probari, Inc., a program to train nurses to reduce nursing home hospital transfers. No other authors have conflicts of interest to disclose.

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Summary: This brief report describes a statewide effort to test nursing home staff and assesses the feasibility of using community COVID-19 activity level to adjust testing frequency. If the goal is to identify all asymptomatic infections comprehensive repeat testing may be needed and should not be based solely on measures of community spread.

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Abstract

Objectives: To assess whether using coronavirus disease 2019 (COVID-19) community activity level can accurately inform strategies for routine testing of facility staff for active severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.

Design: Cross-sectional study

Setting and Participants: 59,930 nursing home staff tested for active SARS-CoV-2 infection in Indiana.

Measures: Receiver operator characteristic curves and the area under the curve (AUC) to compare the sensitivity and specificity of identifying positive cases of staff within facilities based on community COVID-19 activity level including county positivity rate and county cases per 10,000.

Results: The detection of any infected staff within a facility using county cases per 10,000 population or county positivity rate resulted in an AUC of 0.648 (95% CI 0.601-0.696) and 0.649 (95% CI 0.601-0.696), respectively. Of staff tested, 28.0% were certified nursing assistants (CNAs), yet accounted for 36.9% of all staff testing positive. Similarly, licensed practical nurses (LPNs) were 1.4% of staff, but 4.7% of positive cases.

Conclusions and Implications: We failed to observe a meaningful threshold of community COVID-19 activity for the purpose of predicting nursing homes with any positive staff. Guidance issued by the Centers for Medicare and Medicaid Services (CMS) in August 2020 sets the minimum frequency of routine testing for nursing home staff based on county positivity rates. Using the recommended 5% county positivity rate to require weekly testing may miss asymptomatic infections among nursing home staff. Further data on results of all-staff testing efforts, particularly with the implementation of new widespread strategies such as point-of-care

testing, is needed to guide policy to protect high risk nursing home residents and staff. If the goal is to identify all asymptomatic SARS-Cov-2 infected nursing home staff, comprehensive repeat testing may be needed regardless of community level activity.

Introduction

Nursing home residents have been disproportionately affected by the coronavirus 2019 (COVID-19) pandemic. In the US, 33-82% of COVID-19 deaths are residents of long-term care facilities, a proportion similar to Canada and across Europe.[1,2] Underlying conditions, including type 2 diabetes mellitus, serious heart conditions, and chronic kidney disease, make residents at high risk for complications of infection from severe acute respiratory coronavirus 2 (SARS-CoV-2).[3,4] Until recently, facilities had largely shut down visitation and only allowed essential staff, who are screened for SARS-CoV-2 symptoms, to enter and provide care for residents and monitor their health status.[4] Despite these measures, 50,000-80,000 deaths have occurred in long-term care facilities as of October 1, 2020.[2,5] As cases continue to rise, surveillance of infected staff is paramount to protecting nursing home residents.

Asymptomatic transmission of SARS-CoV-2 by staff, followed by rapid spread, is believed to be the major contributing factor to outbreaks in nursing homes.[6,7] On May 18, 2020, CMS first recommended weekly testing of all nursing home staff, but advised that local and state governments could adjust this frequency according to local factors.[8] Resource limitations including testing supply shortages (e.g. swabs, reagents), costs, reporting delays, and logistical issues have challenged states and facilities to develop and implement comprehensive weekly testing programs.[9-11] CMS has begun to distribute 15,000 point-of-care testing machines, along with an initial supply of testing materials, to every nursing home in the United States.[12] Testing capacity is also being supplemented by the distribution of Abbott BinaxNOW point-of-care antigen test cards by the Department of Health and Human Services.[13] New guidance issued by CMS on August 26, 2020 has set the minimum frequency of routine staff testing based on community COVID-19 activity: <5% monthly, 5% to 10% weekly, >10% twice weekly.[14]

Noncompliance with testing frequency as recommended will result in citations and financial consequences.[14] A new SARS-CoV-2 infection in any staff member is considered an outbreak by CMS;[15] relying on community COVID-19 activity level remains an untested strategy to identify any facility with at least one infected staff member.

Methods

The Indiana State Department of Health (ISDH) aimed to test all Indiana nursing home staff in the month of June, 2020. Consistent with the CMS definition, staff included employees, consultants, contractors, volunteers, or other individuals regularly providing care within and on behalf of the facility. Nursing homes acquired samples from staff using test kits provided by ISDH, or requested on-site sampling. All samples were taken using nasopharyngeal swabs for a polymerase chain reaction (PCR)-based test by a laboratory contracted with the ISDH. Facilities could also report results from PCR-based testing done elsewhere. Staff with a documented prior positive PCR test were exempted. Employee demographic information, role, facility name (only one could be chosen), test date, any close contact with a person infected with SARS-CoV-2, and current symptoms were collected during registration for those tested onsite with ISDH test kits. Individuals with inconclusive results were retested. Staff with multiple tests were identified by matching name (first and last) and date of birth, and only the most recent test was included.

Employee data were aggregated to the facility-level. Facility-level measures were calculated to represent the total number of staff tested and the total that tested positive. Facility location was linked with county COVID-19 activity level, for the month of June, as was displayed on the ISDH public dashboard. This included the number of reported cases, number of

tests performed, and number of positive tests. County population estimates were extracted from the 2019 American Communities Survey.

Characteristics of staff overall and by those positive are presented. Facilities were categorized based on whether they had any positive staff or three or more positive staff, which was considered as higher risk of infection to residents. The sensitivity and specificity of both these outcomes were calculated for each observed level of county test positivity rate (0.31% to 25.08%) and cases per 10,000 population (11 to 951). Receiver operator characteristic (ROC) curves were plotted and the area under the curve (AUC) was estimated using the trapezoidal rule.

Results

Of 44,065 staff with complete test results (73% of all nursing home staff), 1% (n=466) were positive for active SARS-CoV-2 infection and 177 facilities (32.5%) had at least one positive staff member. Of staff tested, 35,685 were done so onsite (81.0%) and 8,380 (19.0%) results were confirmed by facilities through outside laboratories. Data were missing for 23.3% of staff statewide, due to missing data or inconclusive results (see Appendix 1). Additionally, some staff were tested prior to June and exempted (1.8%) or were documented as refusing testing (1.3%).

The detection of any positive cases within a facility using county cases per 10,000 population or county positivity rate resulted in an AUC of 0.648 (95% CI 0.601-0.696) and 0.649 (95% CI 0.601-0.696), respectively (Figure 1). The AUC values for detecting facilities with 3 or more positive staff were 0.682 (95% CI 0.612-0.753) for county cases per 10,000 population and 0.691 (0.622-0.760) for county positivity rate.

Certified nursing assistants (CNAs) were 28.0% of staff tested, yet accounted for 36.9% of all staff testing positive (Table 1). Similarly, licensed practical nurses (LPNs) represented 1.4% of staff tested, but 4.7% of positive cases. Of staff tested onsite, 11.6% reported close contact with a SARS-CoV-2 infected person, including 39.1% who tested positive.

Of 544 facilities, 177 (32.5%) had at least one staff member test positive and 47 (8.6%) had three or more (Table 2). Facilities in counties in the highest quartile of community positivity represented 17.8% of all facilities yet 27.1% of facilities with a positive staff member; and 31.9% of those with three or more positive staff. Similarly, facilities in counties with the greatest number of cases per 10,000 population represented 20.6% of all facilities, yet accounted for 30.5% of facilities with a positive staff member; and 36.2% of facilities with three or more positive staff members.

Discussion

If the goal of the CMS testing strategy is to identify all asymptomatic SARS-Cov-2 infected nursing home staff,[14,15] results from Indiana's statewide all-staff testing initiative reveal that some outbreaks may be missed if thresholds are set using community COVID-19 activity. For example, if weekly testing occurred only in facilities within Indiana counties with a positivity rate of 5% or greater, 47.7% of facilities with a positive case would be identified and 21.2% of facilities without a case would be tested. This strategy may miss over half of the facilities with a SARS-CoV-2 infected staff member, particularly if asymptomatic. Based on Indiana's data, in order to capture all facilities with a positive staff (i.e., sensitivity of 100%), the testing threshold must be set at 1% county positivity rate; consequently, this would also test 97% of facilities without any positive staff. As evidenced by AUC values near 0.5, the use of

community COVID-19 activity was slightly better than chance at distinguishing facilities with positive cases versus none.

Other findings from this statewide testing initiative suggest key characteristics of staff and facilities may require additional monitoring. Among CNAs, infections were nearly 9 percentage points greater than expected based on their proportional make-up, and 3 percentage points greater for LPNs. Both roles provide direct patient care and present higher risk of staff-to-resident or resident-to-staff transmission than other roles. Likewise, facilities with the most staff were overrepresented with positive cases, perhaps because of more potential exposures by staff outside the facility or because these were located in areas with greater transmission. Although its usefulness is limited in guiding testing efforts, per our results, we do observe facilities are more likely to have SARS-CoV-2 infected staff in areas with higher COVID-19 activity. As the nursing home industry, state and federal governments grapple with the logistics and costs of ongoing staff testing, thresholds to determine frequencies needed to identify outbreaks quickly will require continued examination.

Our analyses have limitations which include using cross-sectional data not suited for determining cause-and-effect. Although we used the official state counts for community COVID-19 spread, we recognize that the data systems and reporting procedures are rapidly evolving and could affect our conclusions as data quality improves. Missing information and staff refusal rates may have affected our conclusions, as approximately 21% of the estimated number of staff had missing data. A considerable number of staff were on extended leave due to COVID-19 concerns and likely contributed to this proportion with missing data. This missing data also highlight challenges to facilities in administering and coordinating testing efforts and the lack of any prior infrastructure for facilities to report results for state officials to monitor. Furthermore, per current

CMS guidance, nursing homes are required to ensure testing is done not just for employed staff, but consultants and contractors as well. The small numbers of physicians and advance practice providers who were tested during this state-sponsored initiative may reflect additional challenges in coordinating testing or receiving test results from outside laboratories for these providers within narrow timeframes.

Conclusions and Implications

Using the recommended 5% county positivity rate to guide weekly testing of all nursing home staff may miss asymptomatic staff in these facilities. Further data on results of all-staff testing efforts, particularly with the implementation of new widespread strategies such as point-of-care testing, is needed to guide policy to protect high risk nursing home residents and staff.

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Figure 1. Receiver operator characteristic curves (ROC) representing community COVID-19 activity levels to guide nursing home staff testing in Indiana.

Figure legend:

A, ROC curve for detecting any positive staff using county cases per 10,000. B, ROC curve for identifying 3 or more positive staff using county cases per 10,000. C, ROC curve for identifying any positive staff using county positivity rate. D, ROC curve for identifying 3 or more positive staff using county positivity rate. Source: Authors' calculations based upon Indiana State Department of Health data from staff tested for SARS-CoV-2 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population data were obtained from the American Communities Survey for 2019 (1-year estimate). Notes: Data represent 44,065 nursing home staff in 544 facilities statewide. AUC = area under the curve.

Table 1. Characteristics of nursing home staff tested for SARS-CoV-2 infection in Indiana during June 2020, overall and by those testing positive for active infection.

	No. of staff with recorded results, %		No. with positive test recorded in June, %	
	N	%	N	%
Total	44,065	73	466	1.1
Age Category				
15-25	8,776	19.9	113	24.2
26-35	9,200	20.9	93	20.0
36-45	9,198	20.9	91	19.5
46-55	8,544	19.4	87	18.7
56-65	6,641	15.1	62	13.3
66-75	1,493	8.4	13	2.8
76+	165	0.4	X	X
Unknown	48	0.1	X	X
Race				
White	25,258	57.3	148	31.8
Black or African American	5,914	13.4	71	15.2
Asian	589	1.3	X	X
Multiracial	601	1.4	X	X
Other	891	2.0	11	2.4
Unknown	10,763	24.4	225	48.3
Hispanic	1,187	2.7	16	3.4
Unknown Ethnicity	12,696	28.8	237	50.9
Role				
Activities	1,545	3.5	X	X
Administration	1,825	4.1	X	X
Certified nursing assistant	12,332	28.0	172	36.9
Dietary	5,251	11.9	39	8.4
Physician	82	0.2	0	0
Nurse practitioner/physician assistant	84	0.2	X	X
Housekeeping	3,503	7.9	21	4.5
Licensed practical nurse	637	1.4	22	4.7
Other	3,473	7.9	27	5.8
Registered nurse (administrative)	1,610	3.7	15	3.2
Registered nurse (patient care)	5,760	13.1	48	10.3
Social Services	545	1.2	X	X
Therapy (physical, occupational, speech)	2,389	5.4	22	4.7
Role not recorded	5,029	11.4	81	17.4
Contact with SARS-CoV-2 infected person[1]				
Yes	4,154	11.5	97	39.1
No	31,493	88.3	151	60.9
Use of tobacco or e-cigarettes[1]				
Some Days	2,256	6.3	26	10.5
Every Day	7,662	21.5	28	11.3

[1]Questions were asked of n=36,685 staff tested on-site, including n=248 with a positive test; this information was not collected for staff members with confirmed PCR-based test results from outside laboratories.

Source: Authors' calculations based upon Indiana Department of Health data from staff tested for SARS-CoV-2 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population

data were obtained from the American Communities Survey for 2019 (1-year estimate). Notes: Cell counts denoted with an “X” are suppressed due small samples (<10) and privacy concerns.

Table 2. Number of staff and measures of community spread of SARS-CoV-2 for nursing home facilities in Indiana during June 2020.

	No. of facilities, %		No. of facilities with any positive, %		No. of facilities with 3+ positive, %	
	N	%	N	%	N	%
Total	544	100	177	32.5	47	8.6
No. of Facility staff (quartiles)						
76 or fewer	147	27.0	27	15.3	3	6.4
77 to 102	133	24.4	35	19.8	7	14.9
103 to 140	142	26.1	49	27.7	15	31.9
140 or more	122	22.4	66	37.3	22	46.8
County positivity rate (quartiles)						
2.33% or less	138	25.6	31	17.5	3	6.4
2.34 to 3.64%	135	25.0	34	19.2	8	17.0
3.65 to 5.33%	172	31.9	63	35.6	21	44.7
5.34% or higher	95	17.8	48	27.1	15	31.9
County Cases per 10,000 population (quartiles)						
74 or lower	139	25.6	30	16.9	6	12.8
75 to 113	134	25.0	33	18.6	4	8.5
114 to 171	156	28.9	59	33.3	20	42.6
172 or higher	111	20.6	54	30.5	17	36.2

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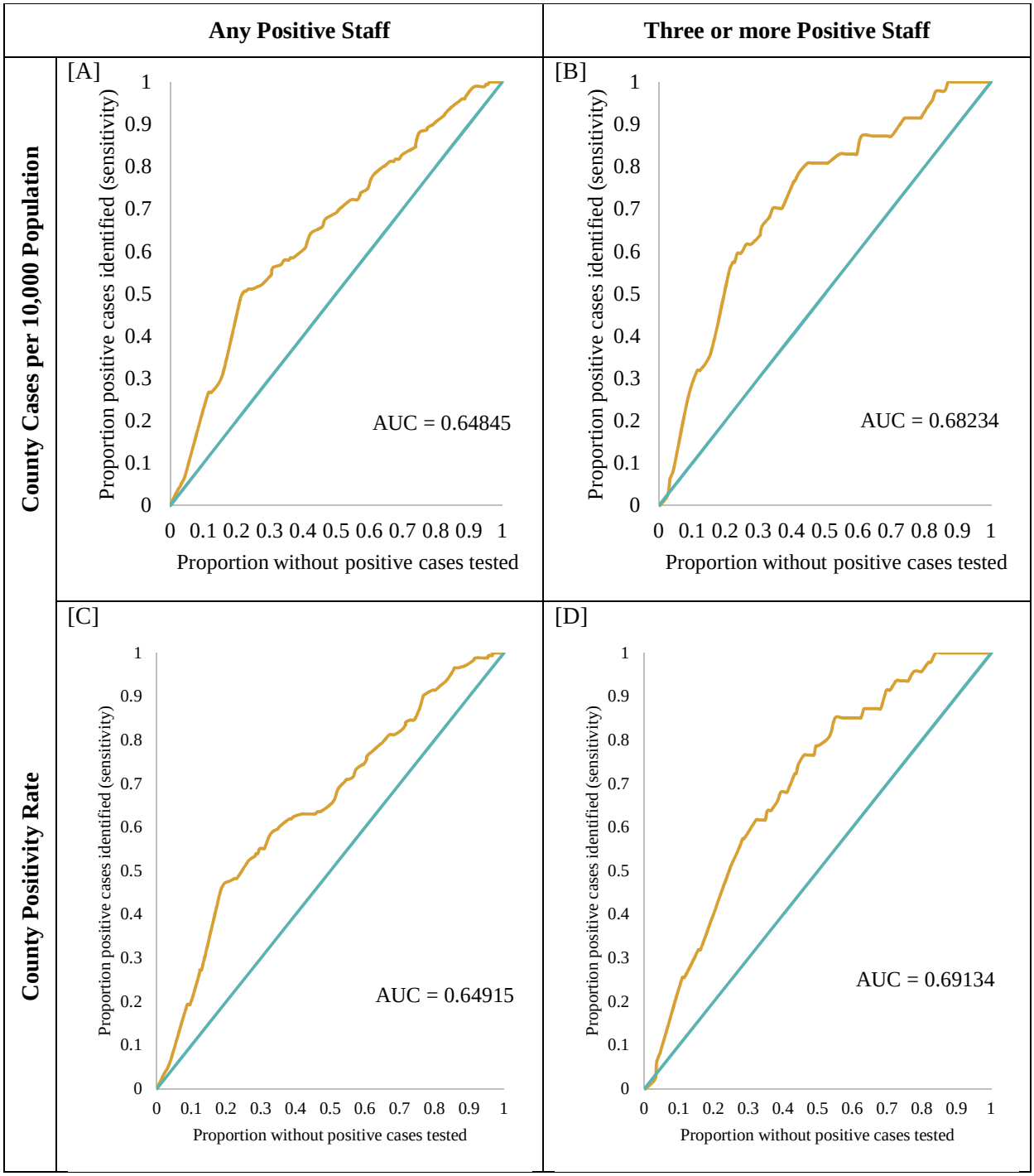

A, ROC curve for detecting any positive staff using county cases per 10,000. B, ROC curve for identifying 3 or more positive staff using county cases per 10,000. C, ROC curve for identifying any positive staff using county positivity rate. D, ROC curve for identifying 3 or more positive staff using county positivity rate. Source: Authors' calculations based upon Indiana State Department of Health data from staff tested for SARS-CoV-2 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population data were

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Of 544 facilities, 177 (32.5%) had at least one staff member test positive and 47 (8.6%) had three or more (Table 2). Facilities in counties in the highest quartile of community positivity represented 17.8% of all facilities yet 27.1% of facilities with a positive staff member; and 31.9% of those with three or more positive staff. Similarly, facilities in counties with the greatest number of cases per 10,000 population represented 20.6% of all facilities, yet accounted for 30.5% of facilities with a positive staff member; and 36.2% of facilities with three or more positive staff members.

Discussion

If the goal of the CMS testing strategy is to identify all asymptomatic SARS-Cov-2 infected nursing home staff,[14,15] results from Indiana's statewide all-staff testing initiative reveal that some outbreaks may be missed if thresholds are set using community COVID-19 activity. For example, if weekly testing occurred only in facilities within Indiana counties with a positivity rate of 5% or greater, 47.7% of facilities with a positive case would be identified and 21.2% of facilities without a case would be tested. This strategy may miss over half of the facilities with a SARS-CoV-2 infected staff member, particularly if asymptomatic. Based on Indiana's data, in order to capture all facilities with a positive staff (i.e., sensitivity of 100%), the testing threshold must be set at 1% county positivity rate; consequently, this would also test 97% of facilities without any positive staff. As evidenced by AUC values near 0.5, the use of

community COVID-19 activity was slightly better than chance at distinguishing facilities with positive cases versus none.

Other findings from this statewide testing initiative suggest key characteristics of staff and facilities may require additional monitoring. Among CNAs, infections were nearly 9 percentage points greater than expected based on their proportional make-up, and 3 percentage points greater for LPNs. Both roles provide direct patient care and present higher risk of staff-to-resident or resident-to-staff transmission than other roles. Likewise, facilities with the most staff were overrepresented with positive cases, perhaps because of more potential exposures by staff outside the facility or because these were located in areas with greater transmission. Although its usefulness is limited in guiding testing efforts, per our results, we do observe facilities are more likely to have SARS-CoV-2 infected staff in areas with higher COVID-19 activity. As the nursing home industry, state and federal governments grapple with the logistics and costs of ongoing staff testing, thresholds to determine frequencies needed to identify outbreaks quickly will require continued examination.

Our analyses have limitations which include using cross-sectional data not suited for determining cause-and-effect. Although we used the official state counts for community COVID-19 spread, we recognize that the data systems and reporting procedures are rapidly evolving and could affect our conclusions as data quality improves. Missing information and staff refusal rates may have affected our conclusions, as approximately 21% of the estimated number of staff had missing data. A considerable number of staff were on extended leave due to COVID-19 concerns and likely contributed to this proportion with missing data. This missing data also highlight challenges to facilities in administering and coordinating testing efforts and the lack of any prior infrastructure for facilities to report results for state officials to monitor. Furthermore, per current

CMS guidance, nursing homes are required to ensure testing is done not just for employed staff, but consultants and contractors as well. The small numbers of physicians and advance practice providers who were tested during this state-sponsored initiative may reflect additional challenges in coordinating testing or receiving test results from outside laboratories for these providers within narrow timeframes.

Conclusions and Implications

Using the recommended 5% county positivity rate to guide weekly testing of all nursing home staff may miss asymptomatic staff in these facilities. Further data on results of all-staff testing efforts, particularly with the implementation of new widespread strategies such as point-of-care testing, is needed to guide policy to protect high risk nursing home residents and staff.

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Figure 1. Receiver operator characteristic curves (ROC) representing community COVID-19 activity levels to guide nursing home staff testing in Indiana.

Figure legend:

A, ROC curve for detecting any positive staff using county cases per 10,000. B, ROC curve for identifying 3 or more positive staff using county cases per 10,000. C, ROC curve for identifying any positive staff using county positivity rate. D, ROC curve for identifying 3 or more positive staff using county positivity rate. Source: Authors' calculations based upon Indiana State Department of Health data from staff tested for SARS-CoV-2 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population data were obtained from the American Communities Survey for 2019 (1-year estimate). Notes: Data represent 44,065 nursing home staff in 544 facilities statewide. AUC = area under the curve.

Table 1. Characteristics of nursing home staff tested for SARS-CoV-2 infection in Indiana during June 2020, overall and by those testing positive for active infection.

	No. of staff with recorded results, %		No. with positive test recorded in June, %	
	N	%	N	%
Total	44,065	73	466	1.1
Age Category				
15-25	8,776	19.9	113	24.2
26-35	9,200	20.9	93	20.0
36-45	9,198	20.9	91	19.5
46-55	8,544	19.4	87	18.7
56-65	6,641	15.1	62	13.3
66-75	1,493	8.4	13	2.8
76+	165	0.4	X	X
Unknown	48	0.1	X	X
Race				
White	25,258	57.3	148	31.8
Black or African American	5,914	13.4	71	15.2
Asian	589	1.3	X	X
Multiracial	601	1.4	X	X
Other	891	2.0	11	2.4
Unknown	10,763	24.4	225	48.3
Hispanic	1,187	2.7	16	3.4
Unknown Ethnicity	12,696	28.8	237	50.9
Role				
Activities	1,545	3.5	X	X
Administration	1,825	4.1	X	X
Certified nursing assistant	12,332	28.0	172	36.9
Dietary	5,251	11.9	39	8.4
Physician	82	0.2	0	0
Nurse practitioner/physician assistant	84	0.2	X	X
Housekeeping	3,503	7.9	21	4.5
Licensed practical nurse	637	1.4	22	4.7
Other	3,473	7.9	27	5.8
Registered nurse (administrative)	1,610	3.7	15	3.2
Registered nurse (patient care)	5,760	13.1	48	10.3
Social Services	545	1.2	X	X
Therapy (physical, occupational, speech)	2,389	5.4	22	4.7
Role not recorded	5,029	11.4	81	17.4
Contact with SARS-CoV-2 infected person[1]				
Yes	4,154	11.5	97	39.1
No	31,493	88.3	151	60.9
Use of tobacco or e-cigarettes[1]				
Some Days	2,256	6.3	26	10.5
Every Day	7,662	21.5	28	11.3

[1]Questions were asked of n=36,685 staff tested on-site, including n=248 with a positive test; this information was not collected for staff members with confirmed PCR-based test results from outside laboratories.

Source: Authors' calculations based upon Indiana Department of Health data from staff tested for SARS-CoV-2 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population

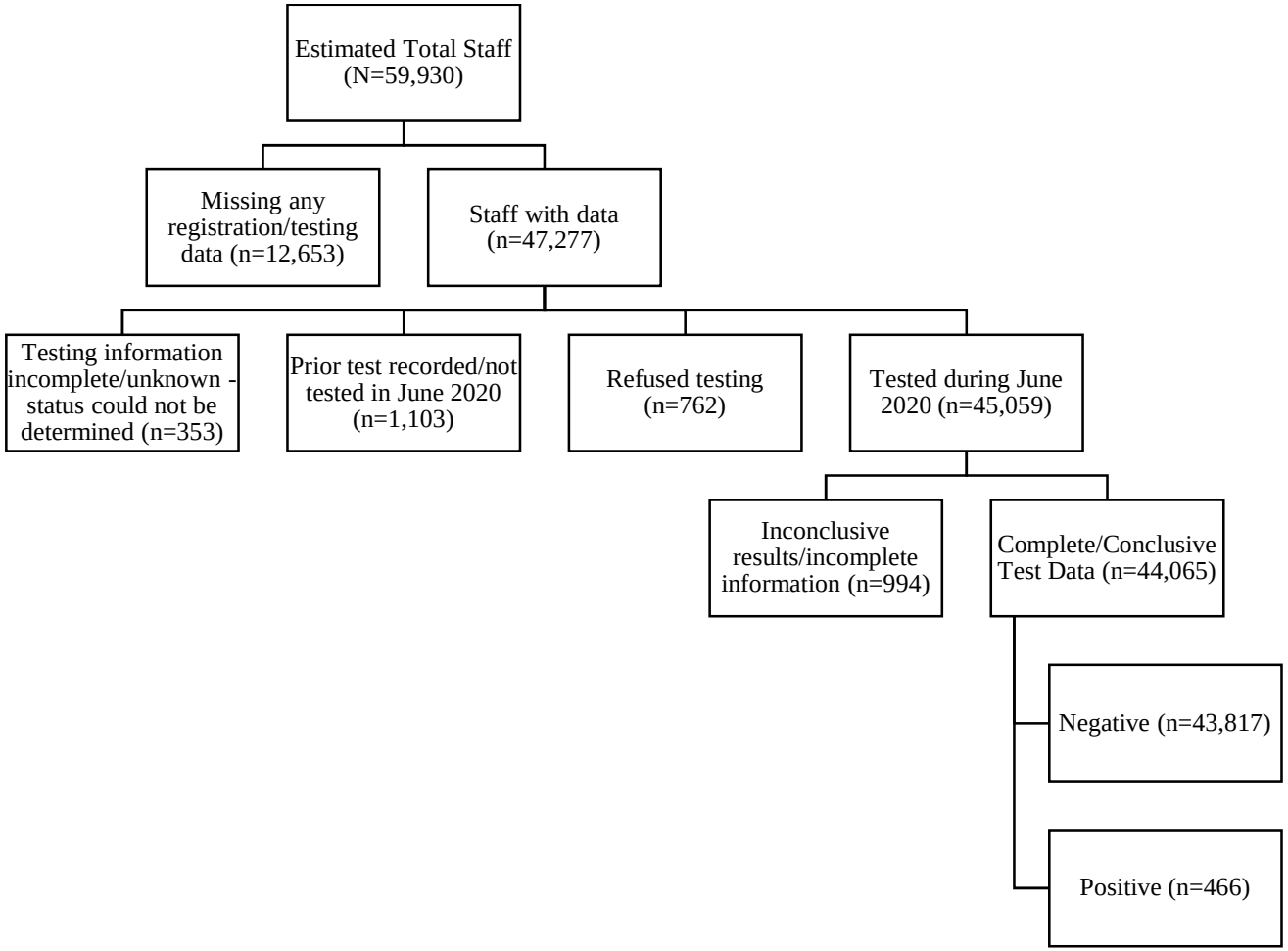
data were obtained from the American Communities Survey for 2019 (1-year estimate). Notes: Cell counts denoted with an “X” are suppressed due small samples (<10) and privacy concerns.

Table 2. Number of staff and measures of community spread of SARS-CoV-2 for nursing home facilities in Indiana during June 2020.

	No. of facilities, %		No. of facilities with any positive, %		No. of facilities with 3+ positive, %	
	N	%	N	%	N	%
Total	544	100	177	32.5	47	8.6
No. of Facility staff (quartiles)						
76 or fewer	147	27.0	27	15.3	3	6.4
77 to 102	133	24.4	35	19.8	7	14.9
103 to 140	142	26.1	49	27.7	15	31.9
140 or more	122	22.4	66	37.3	22	46.8
County positivity rate (quartiles)						
2.33% or less	138	25.6	31	17.5	3	6.4
2.34 to 3.64%	135	25.0	34	19.2	8	17.0
3.65 to 5.33%	172	31.9	63	35.6	21	44.7
5.34% or higher	95	17.8	48	27.1	15	31.9
County Cases per 10,000 population (quartiles)						
74 or lower	139	25.6	30	16.9	6	12.8
75 to 113	134	25.0	33	18.6	4	8.5
114 to 171	156	28.9	59	33.3	20	42.6
172 or higher	111	20.6	54	30.5	17	36.2

Source: Authors' calculations based upon Indiana Department of Health data from staff tested for SARS-CoV-2 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population data were obtained from the American Communities Survey for 2019 (1-year estimate).

Appendix 1. Number and outcome of Indiana nursing home staff tested for active SARS-CoV-2 infection during June 2020.



Notes: The estimated total staff were reported by each facility prior to the launch of the testing effort to enable the Indiana Department of Health to plan for testing supplies and sample collection.